Utilization of lime sludge as filler grade pigment

Singh S. P., Kumar S.*
Vaidyanathan S. B., Prahasam S. R.**
Misra S. P.

Lime sludge is a waste material from the chemical recovery section of a Kraft mill. About 25 TPD lime sludge is discharged from a 100 TPD Paper mill. Ideally this sludge should be recalcined in a lime kiln and reused In causticizing. However, due to high silica content fiberous raw materials, low purity lime, high equipment cost and high fuel cost, the practice of lime sludge recycling is not followed in Indian paper industry. The disposal of vast amount of sludge poses a severe land pollution problem. Moreover, the cost of disposal is an addition to the non return expenses of the Company.

Literature evidences are available suggesting the use of lime sludge as a filler in paper. Comparison of the properties of filler grade calcium carbonate and the lime sludge points towards some significant differences. The most striking difference is in the brightness which is in the range of 70 to 75% for lime sludge against a more than 90% for chemically precipitated calcium carbonate. Other differences being the presence of grits and other soluble impurities like NaOH, Na_2S, Na_2CO_3, etc. If these impurities can be removed and the brightness of the sludge can be increased to above 85% level at economical costs the sludge can be filled into the Paper. The prospects of using more $CaCO_3$ have increased in recent years with the commercial acceptance of alkaline sizing.

BLEACHING OF LIME SLUDGE

Earlier workers have suggested that the free lime content of lime sludge should be neutralised with CO_2 or flue gas, acids or salts. The grits be removed by screening and the large particles reduced by grinding. It has been reported[1,2] that on some cases the colour was improved by bleaching the lime sludge with hypochlorite.

We studied in our laboratory the effect of bleaching of lime with hypochlorite at various levels of available chloride. It was observed that the sludge did not respond to hypochlorite bleaching significantly. Bleaching with hydrogen peroxide, sodium chlorite and sodium dithionite were also tried. No appreciable improvement in brightness was observed in all these cases.

DETERGENT WASHING

After failing to improve sludge brightness by chemical bleaching, it was decided to wash the sludge by some sutface active agents. The commonly used domestic ditergent 'SURF' was tried which indeed gave large improvements in the sludge brightness.

Several experiments were conducted using detergent at varying dsoes, slurry consistency and temperature. Detergent washed sludge when bleached with hypochlorite showed an improvement in brightness by about 2 degrees.

Table—1 summarises the brigtness of sludge at different stages of treatment.

Table—1

Brightness of sludge at different stages of treatment.

Method treatment of sludge	Brightness, % (Elrepho)
1. Untreated sludge	74.2
2. Hot Water washing	75.0
3. Calcium hypochlorite bleaching (0 3% available Chlorine)	77.4
4 Washing by 1% detergent	82.0
5. Detergent washing (1%) + Hypo bleaching (.3% available Chlorine)	84.2
6. Detergent (1%) + Hypo (0.3%) + detergent (0.5%)	84.8

*Institute of Paper Technology Saharanpur
**Sheesasyee Paper and Board Mills Ltd., Erode
***Nepa Newsprint Mills Ltd., Nepanagar

REMOVAL OF GRITS AND OBTAINING DESIRED PARTICLE SIZE

In the laboratory the gritty matter present in the washed sludge was removed by the method of differential settling. When allowed to settle freely the grit particles owing to their greater settling velocils reach the bottom of the vessel quickly where as tne fine $CaCO_3$ particles still remain in suspension to be separated easily. It appears that the method of sedimentation can be commercially applied for the separation of grits and coarser particles.

It is well known that the temperature in the causticizing reaction has a great effect on the particle size of the $CaCO_3$ formed during that reaction. At present the selection of temperature in the causticizers is mainly based on the consideration that the sludge settles fast enough for efficient clarification of white liquor at low costs. Where sludge can find its application as filler in the paper the conditions in the causticizing plants can be adjusted to yield fine particulate $CaCO_3$.

Fig. 1 shows the major components in the suggested process for lime sludge treatment.

CONCLUSION

1. The limited laboratory experiments suggst that the lime sludge from the causticizing plant can be converted into a filler grade $CaCO_3$ pigment. The filler prepared in laboratory was added in hard sheets to study its effect on brightness and opacity of the paper. The comparison of the properties of the hand sheets without any filler and the laboratory prepared filler is shown in table—2.

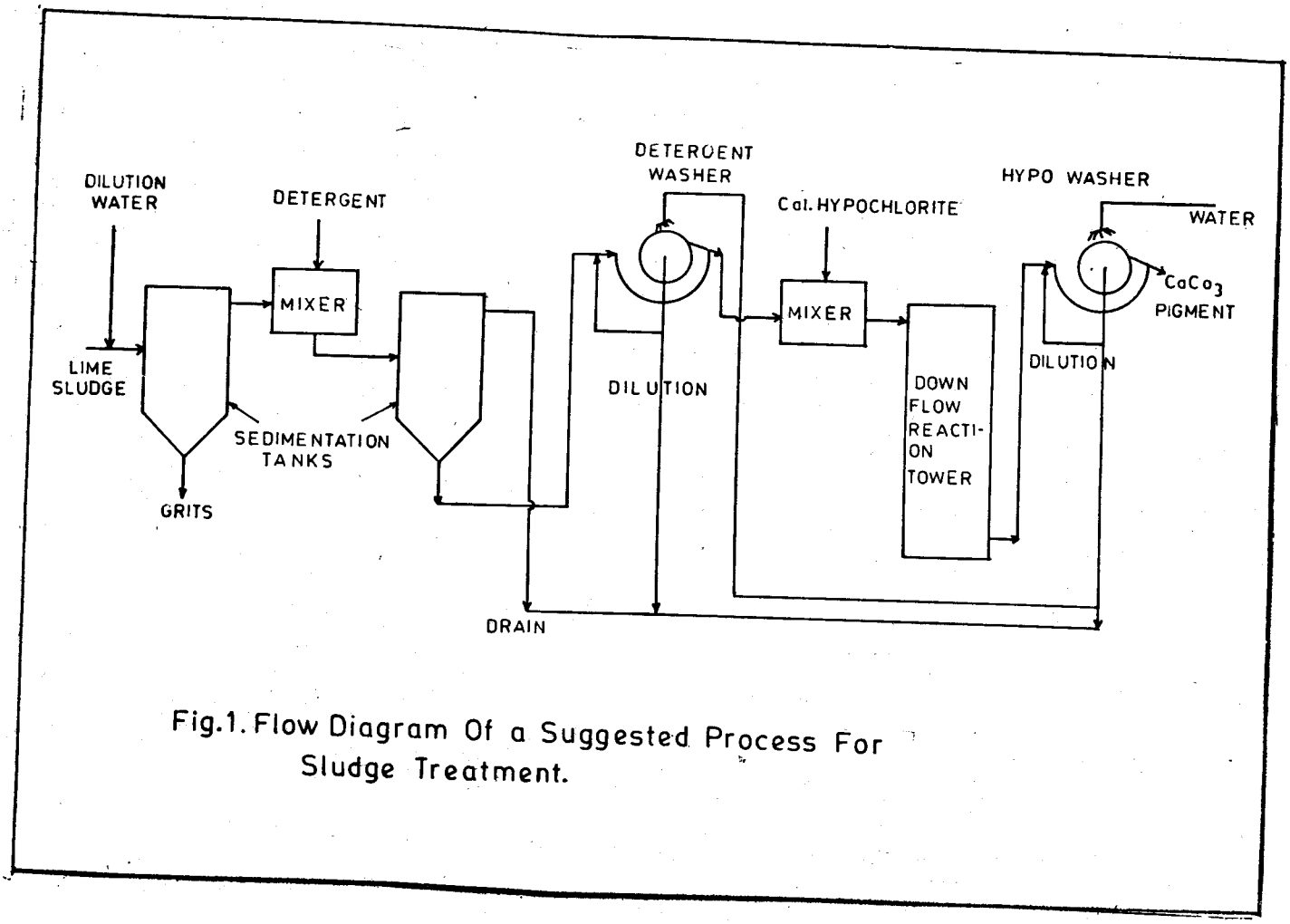

Fig.1. Flow Diagram Of a Suggested Process For Sludge Treatment.

Table—2

Effect of filling of treated lime sludge on the optical properties of paper

Property	Hand sheets without filler	Hand sheets with filler
Ash, %	1.2	16.4
Brightness % (Elrepho)	68	72.0
Opacity	91.5	94.5

Pulp : Bleached bamboo pulp beaten 50 °SR
Basis wt. : 60 gsm
Sizing : 1% rosin and 5% alum (at pH ≈ 7)
Filler : 30% on the o.d. fiber.

The designing of the equipment and cost analysis have to be carried out to study the economic feasibility of the system.

2. The brightness of the washed sludge increases with the increasing dose of detergent in our case.
3. The effectiveness of washing increases with increasing temperature upto about 60° C above which the increase is very less.
4. Detergent washing is fast and only 2 minutes were sufficient for this treatment. However, it is important to wash the slurry at very low consistency (less than 5%) and under vigorous agitation.
5. Available chlorine dosage of about 0.3% was found to be optimum fore bleaching of sludge. The best temperature and reaction time were found to be 45 °C and 5 minutes respectively. The Chlorine concentration falls greatly at low consistency of slurry. Therefore, for the hydrochlorite treatment a high consistency of slurry is recommend as long as it poses no great problems in other operations such as agitation and pumping.

REFERENCES

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